

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

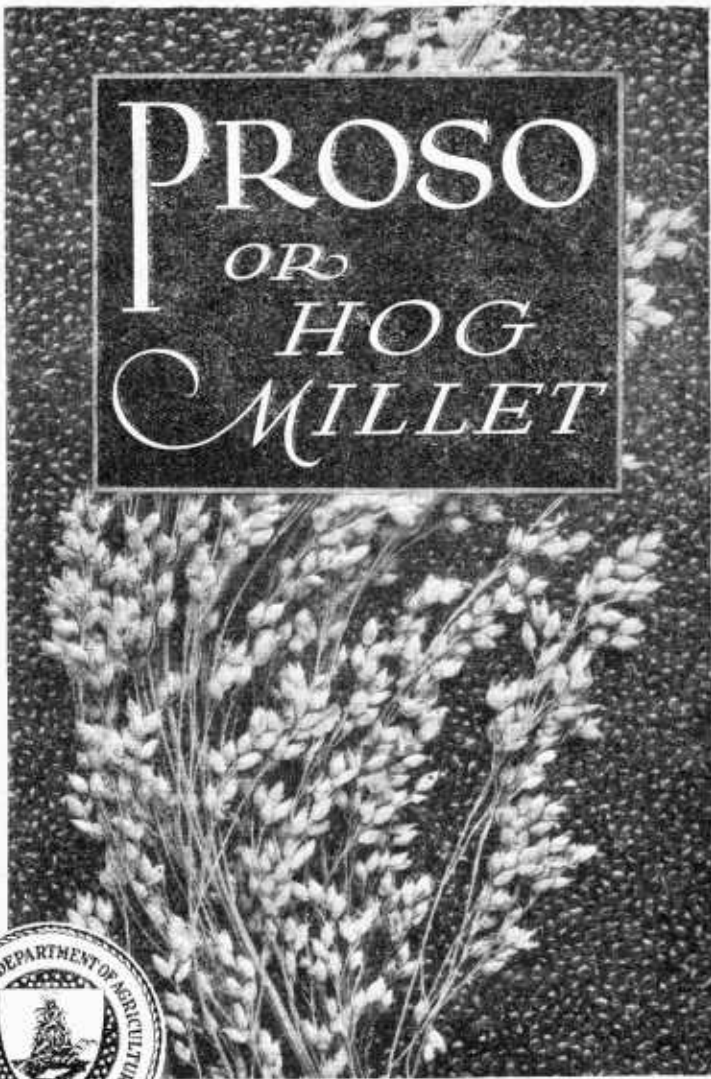
984F

LIBRARY
RECEIVED
1029
U. S. Department of Agriculture

U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1162 *Rev*
Oct. 1929

PROSO *OR* HOG MILLET



PROSO is an early maturing millet, the seed of which is used for grain. It is best adapted to the northern prairie and Great Plains sections of the United States, where it is grown to a limited extent as a late-sown catch crop.

Proso produces fair yields of seed with a limited supply of moisture, but can not withstand severe drought. Other grains usually yield more than proso, but they must be sown earlier.

Turghai, Red Russian, Tambov, and Black Voronezh are the highest yielding varieties of proso.

Proso should be sown with a grain drill at the rate of 1 to 3 pecks per acre, from a few days to two weeks after corn-planting time, but it will usually mature seed if sown even as late as July 1. It is harvested and threshed like other small grains.

In the United States proso is used chiefly for birdseed, poultry, and stock feed.

PROSO, OR HOG MILLET

By JOHN H. MARTIN, *Agronomist, Office of Cereal Crops and Diseases, Bureau of Plant Industry*

CONTENTS

	Page		Page
Description.....	1	Date of sowing.....	10
The place of proso in our agriculture.....	2	Harvesting.....	10
Climatic requirements.....	4	Threshing.....	10
Soils adapted to proso.....	5	Uses of proso.....	11
Varieties.....	5	Human food.....	11
Preparation of the soil.....	9	Feed for livestock.....	11
Method of sowing.....	9	Diseases and pests of proso.....	12
Rate of sowing.....	9	Weight of proso per bushel.....	12

DESCRIPTION

PROSO, or proso millet, is the common millet of the Old World which has been grown since prehistoric times as an important grain crop for human food. It probably was first introduced into the United States by Russian immigrants and is grown only to a limited extent here.

In addition to the names proso and proso millet, this crop in this country is often called hog millet because of its frequent use as hog feed; broomcorn millet because of the shape of the head or panicle, which somewhat resembles the brush of broomcorn; "hershey" millet, apparently an Americanization of the German word hirse, meaning millet; and Early Fortune millet or Manitoba millet if it consists of either of these two varieties.

Proso is distinguished from foxtail millet¹ and barnyard millet chiefly by the head or inflorescence (the seed-bearing part), which is a large open-branching panicle like oats. Proso has coarse, woody, hollow stems from 12 to 48 inches, but usually about 30 inches high. The stems are round or flattened and generally about as thick at the base as a lead pencil. The stems and leaves are covered with hairs. The stem and outer chaff are green, or sometimes yellowish or reddish green, when the seed is ripe. When threshed, most of the seed remains inclosed in the inner chaff or hull. The seed of proso is larger and not so tightly held in hull as is that of the millets of the foxtail group. The hulls of proso are of various shades and colors, including white, cream, yellow, red, brown, gray, and black. The bran, or seed coat, of all varieties is a creamy white. Plants of proso and foxtail millets are shown in Figure 1, and heads of some of the leading varieties of foxtail millet in Figure 2.

The proso flower may be either cross-fertilized or self-fertilized. When two varieties are grown side by side considerable mixing results, but not enough to change the appearance of the variety.

¹ For a more complete discussion of the millets of the foxtail group, see VINALL, H. N., FOXTAIL MILLET: ITS CULTURE AND UTILIZATION IN THE UNITED STATES, U. S. Dept. Agr., Farmers' Bul. 793, 28 p., illus., 1917.

THE PLACE OF PROSO IN OUR AGRICULTURE

According to the census of 1909, the latest available statistics, the leading States in the production of millet were Kansas, Missouri, Nebraska, and North Dakota. A large part of this, especially in the southern portion of this region, consisted of millets of the foxtail group which were cut for hay. No statistics are available to show the acreage of proso, but it is a minor crop. Seed companies in all parts of the United States offer proso seed for sale. It has been found to be best adapted to the northern prairie and Great Plains areas, including Minnesota, the Dakotas, Montana, and Wyoming, and sometimes

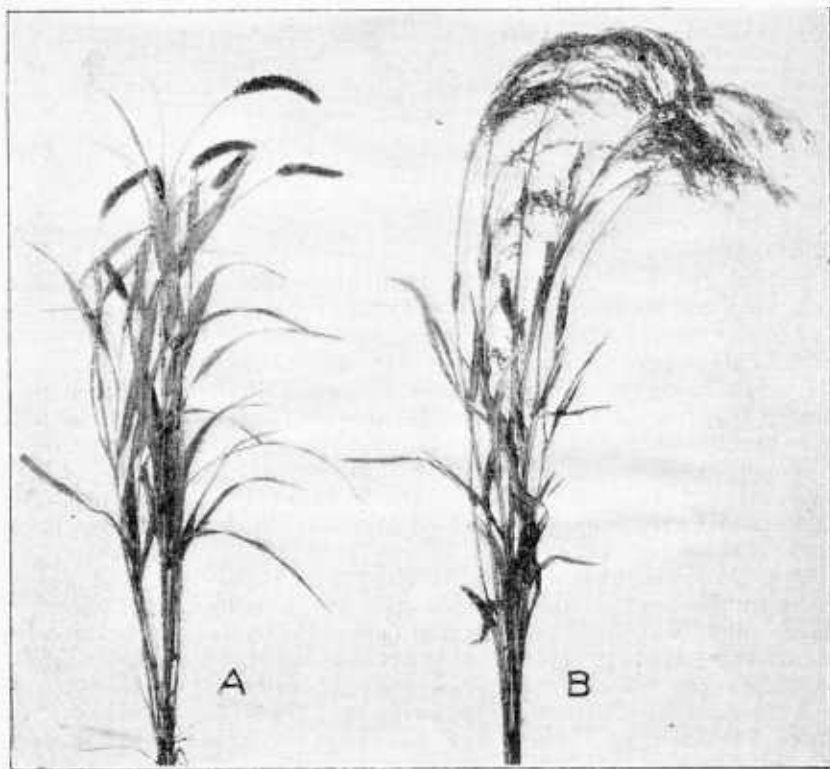


FIGURE 1.—A, Plants of Kursk foxtail millet; B, Black Voronezh proso

is successful in Kansas and Colorado. In the Texas Panhandle it is about as successful as other spring small grains.

Proso should be grown only as a catch crop and not as a part of a regular rotation. Under average conditions other cereals will out-yield proso if they are sown at the proper time. In some localities other crops are more productive than proso even when sown late as catch crops. In the northeastern United States buckwheat is the best catch crop for grain; in the Southwest, grain sorghums are the most productive. In the humid sections of the United States millets of the foxtail group produce more seed than proso and are to be preferred as a hay crop. Flax is a more profitable catch crop than proso under

certain conditions in Minnesota and the Dakotas, but proso can be grown on "flax-sick" soil. It will fight weeds somewhat better than flax, but not so well as foxtail millet; and it is not advisable to sow it on weedy land.

In nearly all localities where it is grown, the average yield of proso in pounds of grain per acre is less than that of wheat, oats, or barley. In rather dry seasons, however, proso often outyields other grains. In the Great Plains area and the northern prairie region a variety

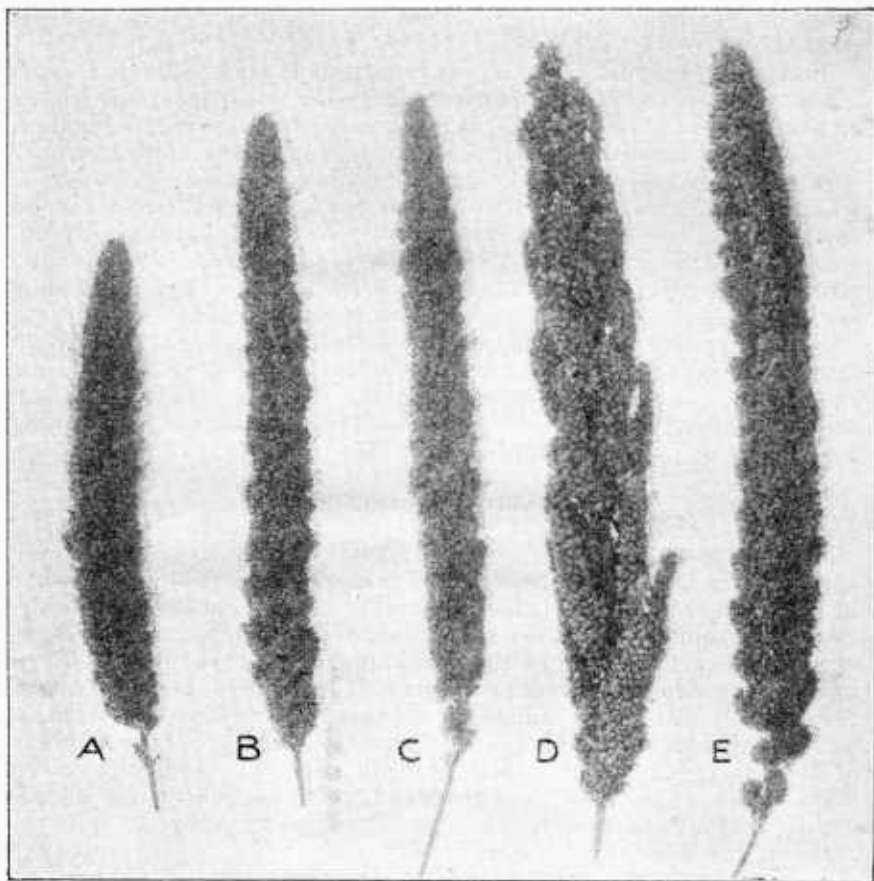


FIGURE 2.—Heads of five varieties of millet: A, Kursk; B, Hungarian; C, Common; D, Japanese; E, Siberian. These millets are principally grown for hay. The Japanese millet is closely related to the common barnyard grass; the others are foxtail varieties

of foxtail millet known as Kursk is grown to some extent. This produces more and better hay than any of the earlier maturing proso varieties. A selected strain of Kursk millet has produced more seed than proso in the Panhandle of Texas, in eastern South Dakota, and in southeastern Wyoming. In the central and western portions of North Dakota and South Dakota the best varieties of proso have produced more seed than Kursk millet, although some of the extremely early and also some of the rather late varieties of proso have

yielded less than Kursk millet. At some agricultural experiment stations where Kursk millet has outyielded proso, the best varieties of proso were not grown.

The best varieties of proso mature one to four weeks earlier than any variety of foxtail millet and can be sown that much later with a chance of obtaining a seed crop. They usually produce more seed than the foxtail millets on a limited supply of moisture. The seed of proso is larger, more easily ground for feeding, and probably makes a better feed than that of the foxtail millets. Proso should be sown in preference to foxtail millets only where a crop of grain is desired.

The place of proso in our agriculture thus is largely limited to its use as a late-sown catch crop for grain in the northern Great Plains area and a few other sections. When a crop of winter wheat has been destroyed by winterkilling or soil blowing, or when small grain or corn is destroyed by frost, hail, insects, floods, or early drought, or when seed of an early sown crop does not germinate, proso can be sown even as late as July 1 with good chances of obtaining a crop. Proso usually is sown on sod or stubble land which was plowed too late to sow to other crops. This permits a larger crop acreage than is possible where only early sown crops are grown.

Under extremely favorable conditions proso yields from 60 to 70 bushels per acre, but yields of 10 to 30 bushels per acre are the general rule. When sown at the most profitable rates of 1 to 3 pecks per acre, the rate of increase is not abnormally high, and the cost of seed for an acre of proso is as much as for other grains.

CLIMATIC REQUIREMENTS

Proso is sown in the spring and is adapted only to regions where spring grain is fairly successful. It is easily injured by frost either in the spring or fall and is not adapted to high altitudes or to localities where summer frosts occur. Moderately warm weather is necessary for the germination of the seed and growth of the plant. Even under favorable conditions proso grows very slowly during the first few weeks. Early and midseason varieties of proso require from 50 to 90 days from sowing to maturity, and unless there is a probability of at least 60 days until a killing frost occurs proso should not be sown. This crop does not ripen well, and frequently not at all, during cool autumn weather.

Proso has the lowest water requirement of any grain crop. At Akron, Colo., only about two-fifths as much water was required to produce a ton of proso seed as was necessary to produce a ton of grain of Kubanka durum wheat. Largely because of its shallow rooting habit, however, proso is less resistant to severe drought than well-adapted varieties of other grains and is sometimes a complete failure where wheat or barley produces a fair crop. Hot winds occasionally dry and kill the plant before it forms seed, even when there is available moisture in the soil. Proso is reported to produce crops in Siberia under an annual precipitation of 8 inches, but it can not be expected to do this in the United States, nor can it be regarded as even a safe crop during extremely dry seasons in the western portions of the Great Plains area. Attempts have been

made to exploit proso fraudulently as a very high-yielding dry-land crop.

Proso is not so well adapted for growing under irrigation as most other crops, largely because it does not make sufficient use of an abundant supply of moisture.

SOILS ADAPTED TO PROSO

Proso is best adapted to a rich loam soil, but grows satisfactorily on nearly all types except coarse sandy soils. The proso plant is shallow rooted and a gross feeder, so that an abundant supply of available plant food near the surface of the soil is desirable. A crop of proso usually leaves the upper layers of soil somewhat impoverished, because of its shallow rooting and feeding habits.

VARIETIES

The varieties of proso are divided into three main groups, according to the shape of the head or panicle. Heads of each of these three groups are shown in Figures 3 and 4. These are further subdivided according to color of seed, color of chaff, height, and time of maturity.

Following is a key to the leading varieties of proso grown in the United States or proving of value in experiments conducted by the United States Department of Agriculture. The characters are also shown in Table 1.

KEY TO VARIETIES OF PROSO

Panicle spreading (*Panicum miliaceum effusum* Kcke.)

Seed white to yellow.

Chaff yellowish green.

Early to midseason.

Plant short to midtall.

Seed creamy white----- White Ural.

Seed brownish yellow----- Hansen White Siberian.

Seed red to brown.

Chaff partly reddish green.²

Early to midseason.

Plant short to midtall.

Seed reddish brown----- Tambov.

Red Russian.

Plant midtall to tall.

Seed yellowish brown----- Turghai.

Panicle loose, one-sided (*Panicum miliaceum contractum* Kcke.).

Seed white to yellow.

Chaff yellowish green.

Midseason to late.

Plant midtall to tall.

Seed creamy white----- White French.

Seed brownish yellow----- Yellow Manitoba.

Seed red to brown.

Chaff yellowish green.

Early to midseason.

Plant short to midtall.

Seed reddish brown----- Red Orenburg.

Seed brown to black.

Chaff yellowish green.

Midseason to late.

Plant midtall to tall.

Seed brownish black----- Black Voronezh.

² Shortly before maturity the outer chaff becomes tinged with dark red or purple.

Panicle compact, erect (*Panicum miliaceum compactum* Keke.).

Seed red to brown.

Chaff yellowish green.

Early to midseason.

Plant short to midtall.

Seed reddish brown----- *Red Voronezh.*
Yellow Sarcpta.
Early Fortune.
Red Lump.

All of the varieties of proso listed in the key, except possibly the White French, were originally introduced from Russia or Siberia.

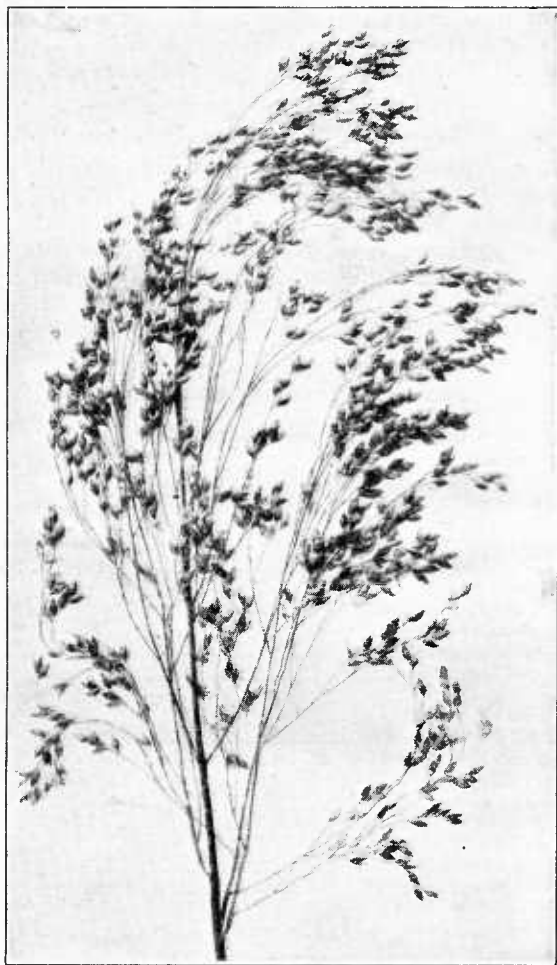


FIGURE 3.—A head of Turghai proso, showing the spreading type of panicle

Numerous varieties of proso introduced from China, India, and Italy have produced poor yields, chiefly because of their late maturity and susceptibility to drought. Altogether, more than 160 different lots of proso, representing many different varieties, have been

obtained by the United States Department of Agriculture and grown in experiments, but only a few of these have produced good yields.

The leading varieties of proso now grown in the United States are the Yellow Manitoba and Early Fortune. The Hansen White Siberian, Red Russia, Turghai, Tambov, White French, Red Lump, and Black Voronezh are grown to a less extent, and considerable proso is grown without a name except the term "hog millet." The other varieties shown in the key have been grown only experimentally.

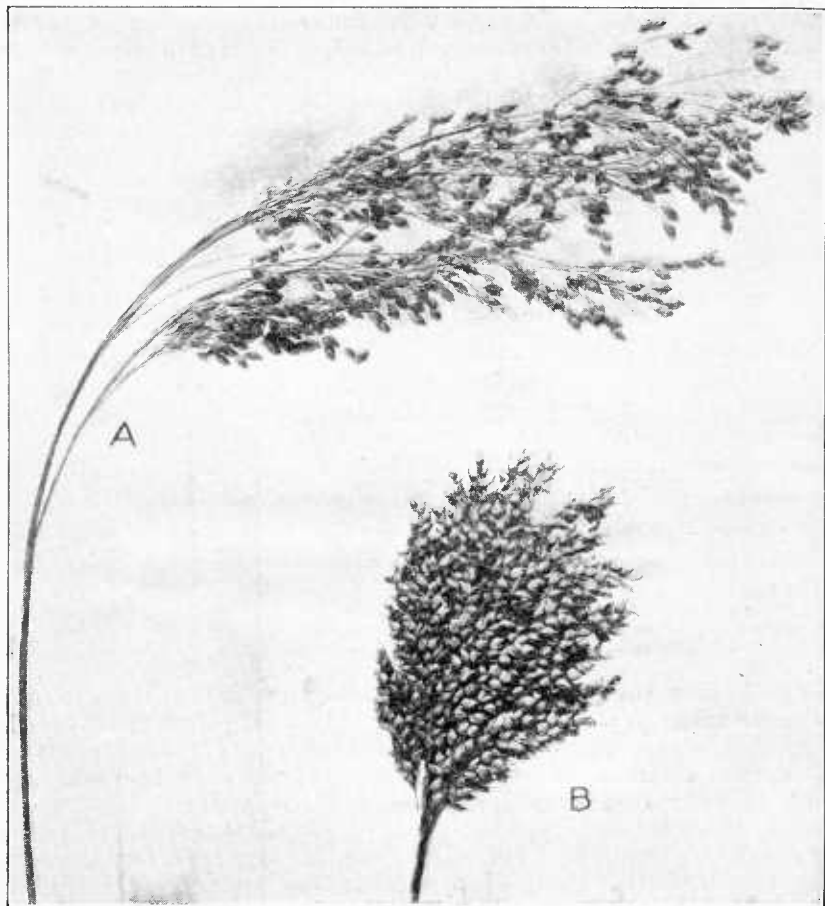


FIGURE 4.—A, Head of Black Voronezh proso, showing the loose one-sided type of head; B, Red Lump proso, showing the compact type of head

The Early Fortune, Yellow Manitoba, and White French varieties have been grown in the United States for many years. The White Ural, Tambov, Red Russian, Red Orenburg, Black Voronezh, Red Voronezh, and Yellow Sarepta varieties were first introduced into the United States from Russia by M. A. Carleton, of the United States Department of Agriculture, in 1899 and 1900. The Turghai variety was introduced from Russia by E. A. Bessey, of the United States Department of Agriculture, in 1903. The Red Lump proso

was introduced from Russia by N. E. Hansen, of the South Dakota Agricultural Experiment Station, in 1898, while acting as an explorer for the United States Department of Agriculture. Professor Hansen also introduced the Hansen White Siberian variety from Siberia in 1913, when he was employed by the State of South Dakota.

The Black Voronezh has produced the highest average yields in extended experiments with proso varieties at Amarillo, Tex. It frequently yields well in other localities, but matures rather late. A head of this variety is shown in Figure 4. In North Dakota, South Dakota, and Wyoming a variety known as Turghai has in general produced the highest average yields. A head of Turghai proso is shown in Figure 3. The Tambov and Red Russian varieties have yielded nearly as well. All three of these latter varieties are medium early in maturing and have yellowish or reddish brown seeds.

TABLE 1.—*Characters of the leading varieties of proso*

Varieties	Character of panicle, or head	Color of outer chaff	Color of seed hull	Season of maturity	Height of plants
White Ural.....	Spreading.....	Yellowish green.	Creamy white..	Early to mid-season.	Short to midtall.
Hansen White Siberian.	do.....	do.....	Brownish yellow.	do.....	Do.
Tambov.....	do.....	Reddish green..	Reddish brown.	do.....	Do.
Red Russian.....	do.....	do.....	do.....	do.....	Do.
Turghai.....	do.....	do.....	Yellowish brown.	do.....	Midtall to tall.
White French.....	Loose, one-sided	Yellowish green.	Creamy white..	Midseason to late.	Do.
Yellow Manitoba..	do.....	do.....	Brownish yellow.	do.....	Do.
Red Orenburg.....	do.....	do.....	Reddish brown.	Early to mid-season.	Short to midtall.
Black Voronezh.....	do.....	do.....	Brownish black.	Midseason to late.	Midtall to tall.
Red Voronezh.....	Compact, erect	do.....	Reddish brown.	Early to mid-season.	Short to midtall.
Yellow Sarepta.....	do.....	do.....	do.....	do.....	Do.
Early Fortune.....	do.....	do.....	do.....	do.....	Do.
Red Lump.....	do.....	do.....	do.....	do.....	Do.

The Yellow Manitoba and White French varieties mature too late to be of value in the northern Great Plains area, but yield well in favorable seasons and under humid conditions. The Early Fortune is the most common variety of the so-called red-seeded prosos. Because of its small growth and extremely early maturity this variety usually produces small yields. Some of the Early Fortune is grown in a mixture with Red Russian. The Red Lump variety is nearly identical with the Early Fortune, but the seeds have a slightly different color. A head of the Red Lump variety is shown in Figure 4. The Red Orenburg, Red Voronezh, and Yellow Sarepta are early red-seeded varieties of minor importance which have not produced large average yields. The latter two are apparently identical.

The white-seeded prosos are preferable for food purposes because the white hulls are not so noticeable in the meal or flour as are red or black hulls, and it is almost impossible to remove all the hulls before grinding. This is of no importance in stock feed, however. The early white-seeded varieties White Ural and Hansen White Siberian do not yield as well in South Dakota as the Turghai, Tambov, or Red Russian. At Brookings, S. Dak., in four years experi-

ments the Tambov variety yielded 32 bushels per acre, Black Voronezh 31 bushels, and the Hansen White Siberian only 21.7 bushels per acre. At Cottonwood, S. Dak., the Tambov variety has a 4-year average acre yield 2.1 bushels higher than the Hansen White Siberian. At Highmore, S. Dak., in four years' experiments the Hansen White Siberian yielded only 11.3 bushels per acre, while during the same period the Turghai yielded 20.1 bushels, the Black Voronezh 16.9 bushels, and the Tambov 16.8 bushels per acre. At Newell, S. Dak., in three years' experiments the Hansen White Siberian produced an average yield of 26.5 bushels per acre, the White Ural yielding 30.7 and the Red Russian 32.6 bushels per acre. The White Ural thus yielded 4.2 bushels per acre more than the Hansen White Siberian. It is a few days earlier, has whiter hulls, and is thus preferable to the latter variety for food purposes. The White Ural variety is not now grown commercially. The Red Russian has outyielded all other varieties at Dickinson, N. Dak.

PREPARATION OF THE SOIL

The seed bed for proso should be moist, smooth, and rather compact, so that prompt germination will give the plants a chance to compete with weeds. If the land is weedy it should be disked and harrowed just before seeding. The harrowing also smooths and compacts the seed bed. Late spring plowing or breaking should be thoroughly disked and harrowed before seeding, as many nonuniform stands of proso are due to an uneven seed bed. Corn or potato ground should be disked and harrowed. Land on which a grain crop has failed should be disked and harrowed if weeds or scattering plants of grain remain, but if the field is clean no further preparation usually is necessary before seeding. Proso doubtless will produce the highest yields on summer-fallowed land or following a tilled crop, such as corn or potatoes, but such land can be more profitably sown to other grain.

METHOD OF SOWING

Proso should always be sown with a grain drill in order to get uniform stands with the least quantity of seed. It should be sown in about the same manner as flaxseed. Seeding in the regular drill rows, 6 to 8 inches apart, has produced higher yields than seeding in wider spaced rows and cultivating between them. At Newell, S. Dak., proso sown in 7-inch drill rows yielded 8.9 bushels per acre more than that sown in 21-inch rows. In a good seed bed three-fourths of an inch to an inch is deep enough to sow, and the depth should never be more than 1½ inches. In a sandy or a dry soil the seed may be sown deeper than in a moist, compact soil.

RATE OF SOWING

Proso should be sown at about the same rate per acre as flax. In the semiarid sections 15 to 25 pounds per acre is ample. At Newell, S. Dak., in 1917, proso sown at the rate of 22 pounds per acre yielded 2 bushels per acre more than when sown at the rate of 15 pounds per acre and about the same as when sown at 30 pounds per acre.

In the humid sections proso should be sown at the rate of 2 to 3 pecks per acre. It is usually not profitable to sow less than 15 pounds per acre under any conditions, because of the decreased yields. In sowing proso the drill should be adjusted as if to sow flax at the rate desired. Internal force-feed drills when adjusted to sow 2 pecks of wheat will sow about 33 to 35 pounds of proso per acre. This rate can be decreased by the use of wire or shell reducers, which are furnished by the manufacturers as extra equipment for their grain drills.

DATE OF SOWING

Proso will not germinate in cold soil. The plants are easily killed by severe frosts in the spring. Seeding should be delayed until the danger of frost is practically over. Profitable yields have occasionally been obtained from seeding as late as July 1 or even later, but this is not dependable. Proso is easily injured by early fall frosts and does not mature seed well in cool weather. At Highmore S. Dak., the highest yields have been obtained by seeding about June 1. Fair average yields have been obtained by sowing between May 15 and June 15. Most varieties of proso require about 60 to 80 days from seeding to maturity. Seeding should be early enough to avoid early fall frosts. The date of seeding depends also on the supply of soil moisture, as it is not advisable to sow in a dry soil. A fair general rule is to sow proso from a few days to two weeks after corn is planted.

HARVESTING

Proso should be harvested when the seeds in the upper half of the heads are ripe. At this stage the plant is still green. If cut earlier there will be much immature seed and if cut later considerable seed will be lost from shattering. If cut too green, there is danger of the straw molding. Proso seed is easily shattered when ripe and the crop should be handled carefully to prevent loss. The binder is usually the best machine for cutting proso. If the plants are too short to bind, the crop can be cut with a mower and raked and shocked like hay, but more seed is shattered out by this method.

The bundles left by the binder should be placed in rather small or long and narrow shocks to prevent molding and to permit early drying. The crop should be removed from the field as promptly as possible in order to prevent loss and damage from birds and field mice, which seem to prefer proso to any other grain.

THRESHING

The seed of proso is separated from the straw very readily with an ordinary threshing machine. Two rows of concave teeth usually are sufficient to remove all the seed. The cylinder should be run slowly enough to avoid the hulling of too much seed. The seed is easily cleaned in threshing by the use of flax or millet screens, but certain weed seeds, such as foxtail or pigeon grass, Russian thistle, and mustard, are difficult to remove.

USES OF PROSO

HUMAN FOOD

In certain portions of China, Russia, Siberia, and India, proso is a common article of food. The hulls are removed from the seed in a special machine designed for this purpose and the seed is then ground into a meal.

The meal is cooked into a mush, called "kasha" by the Russians. Proso meal makes an excellent thickening for soups. The South Dakota Agricultural Experiment Station reports that proso flour when mixed with four parts of wheat flour makes a satisfactory substitute for wheat flour. Digestion experiments with bread made from proso indicate that the carbohydrates are as well utilized as in other cereals, but that less than half of the proteins were digested.³ The proso seed has an agreeable taste with a slight nutty flavor, different from other cereals, and is well liked by some people. It is not, however, any more palatable than other cereal products and therefore is not in any special demand as a food in the United States as yet. It is thought by some that it may be possible to develop certain products of proso as cereal foods in this country. As our present foods are selected largely according to habit and custom it would be necessary to educate the public to a demand for a new dish. There are no machines for hulling proso seed on a commercial scale in this country. For home use proso can be ground in a small coffee mill. The hulls then can be removed with a small fanning mill and the coarse meal and flour separated with sieves.

FEED FOR LIVESTOCK

The unhulled proso seed has a composition very similar to that of oats and is slightly higher in feeding value than oats when fed to livestock. Experiments conducted by the South Dakota Agricultural Experiment Station indicate that a bushel of proso weighing 56 pounds is necessary to produce the same gain on hogs as a bushel of barley weighing only 48 pounds and that it produces a greater percentage of lean meat and a softer fat on hogs than does barley. Recent experiments in Colorado indicated that proso was equal in feeding value to corn and barley for pigs and lambs. Proso is eaten very readily by all kinds of livestock but should be ground before being fed. It is relished by poultry, and it is a common ingredient in commercial birdseed. Proso can be fed to chickens in unthreshed bundles, as the seed is shelled out easily by scratching.

Proso is not a hay crop and should not be grown for that purpose. The foxtail millets or other crops will produce more hay or roughage, and proso hay is of poor quality. While the hay may be eaten it is not relished, and considerable waste will result. An examination of the coarse hairy stems of proso shows clearly why stock do not like it.

Proso can be made into silage, but the yields are too small to make it a profitable silage crop.

³ LANGWORTHY, C. F., and HOLMES, A. D. EXPERIMENTS IN THE DETERMINATION OF THE DIGESTIBILITY OF MILLETS. U. S. Dept. Agr. Bul. 525, 9 p. 1917.

Seed dealers frequently make the statement that "the crop is harvested while the plant is still green, so that the straw makes valuable hay." It is true that the stems, leaves, and chaff are still rather green at the time the seed ripens, but, as previously stated, they are not liked by stock. The straw may be fed, however, without injury to livestock.

DISEASES AND PESTS OF PROSO

The only disease of any consequence which attacks proso is smut. This can be controlled by the standard formaldehyde treatment, as applied to wheat.

Chinch bugs attack proso as well as other millets and other grain crops. The same methods of destruction are applicable to this pest on proso as when they injure other spring grains.

Birds, gophers, and field mice are very destructive to proso after the seed is ripe. Harvesting as early as possible and prompt threshing or stacking will prevent much of the loss.

WEIGHT OF PROSO PER BUSHEL

A legal weight for millet seed of 50 pounds per bushel has been established by several of the States, but there is no standard for the United States. Proso is regarded as a millet in these laws. The average weight of clean plump proso seed is about 56 pounds per bushel, and this is the weight used by the United States Department of Agriculture in determining the acre yields.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October 30, 1929

<i>Secretary of Agriculture</i> -----	ARTHUR M. HYDE.
<i>Assistant Secretary</i> -----	R. W. DUNLAP.
<i>Director of Scientific Work</i> -----	A. F. WOODS.
<i>Director of Regulatory Work</i> -----	WALTER G. CAMPBELL.
<i>Director of Extension Work</i> -----	C. W. WARBURTON.
<i>Director of Personnel and Business Administration.</i>	W. W. STOCKBERGER.
<i>Director of Information</i> -----	M. S. EISENHOWER.
<i>Solicitor</i> -----	R. W. WILLIAMS.
<i>Weather Bureau</i> -----	CHARLES F. MARVIN, <i>Chief</i> .
<i>Bureau of Animal Industry</i> -----	JOHN R. MOHLER, <i>Chief</i> .
<i>Bureau of Dairy Industry</i> -----	O. E. REED, <i>Chief</i> .
<i>Bureau of Plant Industry</i> -----	WILLIAM A. TAYLOR, <i>Chief</i> .
<i>Forest Service</i> -----	R. Y. STUART, <i>Chief</i> .
<i>Bureau of Chemistry and Soils</i> -----	H. G. KNIGHT, <i>Chief</i> .
<i>Bureau of Entomology</i> -----	C. L. MARLATT, <i>Chief</i> .
<i>Bureau of Biological Survey</i> -----	PAUL G. REDINGTON, <i>Chief</i> .
<i>Bureau of Public Roads</i> -----	THOMAS H. MACDONALD, <i>Chief</i> .
<i>Bureau of Agricultural Economics</i> -----	NILS A. OLSEN, <i>Chief</i> .
<i>Bureau of Home Economics</i> -----	LOUISE STANLEY, <i>Chief</i> .
<i>Plant Quarantine and Control Administration</i> ...	C. L. MARLATT, <i>Chief</i> .
<i>Grain Futures Administration</i> -----	J. W. T. DUVEL, <i>Chief</i> .
<i>Food, Drug, and Insecticide Administration</i> ...	WALTER G. CAMPBELL, <i>Director of</i> <i>Regulatory Work, in Charge</i> .
<i>Office of Experiment Stations</i> -----	E. W. ALLEN, <i>Chief</i> .
<i>Office of Cooperative Extension Work</i> -----	C. B. SMITH, <i>Chief</i> .
<i>Library</i> -----	CLARIBEL R. BARNETT, <i>Librarian</i> .

This bulletin is a contribution from

<i>Bureau of Plant Industry</i> -----	WILLIAM A. TAYLOR, <i>Chief</i> .
<i>Office of Cereal Crops and Diseases</i> -----	CARLETON R. BALL, <i>Principal</i> <i>Agronomist, in Charge</i> .

13

